David W. Lewis, “What if Libraries Are Artifact-Bound Institutions?” *Information Technology and Libraries*, Dec 1998 v17(1) i4 p191

Libraries are artifact-bound institutions, and as such, will be replaced as the dominant technology for information communication moves from tangible objects to electronic bits on a network. As this transition occurs, it is important to understand not what libraries have done, but rather what they are for. Libraries make information easily, publicly, and cheaply available. They are the means through which organizations and communities subsidize the distribution of information to residents and members. Without such support, information is underused, and its potential benefit is lost. As the library fades as the channel for this subsidy, it is critical that the subsidy itself is not lost. If it is, our organizations will be less effective and our communities poorer. By understanding these issues, librarians can shape the information economy so that institutional and community subsidy is maintained, and new technologies enhance and extend information availability. If preserving the library as an institution is our focus, we will fail in these tasks.

What Are Libraries?

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library \ 1a: a room, a section or series of sections of a
building, or a building itself given over to books,
manuscripts, musical scores, or other literary and sometimes
artistic materials (as paintings or musical recordings)
usually kept in some convenient order for use but not for
sale.

--Webster's Third New International Dictionary of the
English Language, Unabridged, 1991.
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As the definition above makes clear, libraries are fundamentally collections, or as a later part of the definition states, institutions for the custody or administration of collections. Libraries are about gathering, organizing, preserving, and using things. For the past five hundred years most of these things have been printed--books and serials and their derivatives. Before

that, back to the invention of writing, libraries collected other things--handwritten parchment codices, papyrus scrolls, or clay tablets.

As the twentieth century draws to a close, the things libraries collect are in decline. The technology that underlies the communication and storage of knowledge has moved from print on paper to bits on a worldwide network. Marilyn Gell Mason suggests this transition will to be more like the invention of television, which while dominant, coexists with movies, radio, and newspapers, than like the invention of the automobile, which completely displaced the horse and buggy.[1] This may be true, but as both Eli M. Noam and Andrew Odlyzko convincingly argue, printed materials will quickly lose their centrality.[2] As bits on the worldwide network, information is freed from the artifacts that have traditionally contained it. Networked information does of course have a tangible form somewhere, and this collection will still require management, but its use does not require a tangible container.[3] Information in this environment is broadcast or transmitted. An individual does not have to acquire an artifact to acquire the information. In the post-print world, collections--at least local collections, which have been required as the convenient neighborhood storehouses of physical information containers--are no longer necessary. This is truly revolutionary. It means that the institutions previously required to support the older technologies, including libraries, may no longer be necessary. Libraries, then, are in fact artifact-based organizations, and as such, they will decline in importance as information escapes the artifact.

Another way of viewing the changes that are occurring is to consider the classic trade-off that has been the hallmark of traditional information economics. As Philip B. Evans and Thomas Wurster explain, "To the extent that information is embedded in physical modes of delivery, its economics are governed by a basic law: the trade-off between richness and reach."[4] Richness has three components: the amount of information conveyed, or bandwidth; the extent to which it can be customized, and its level of interactivity. Reach is the number of people who can receive the information. Libraries have been a means of providing rich information services, but their reach has generally been limited. Evans and Wurster continue, "The rapid emergence of universal technical standards for communication, allowing everybody to communicate with everybody else at essentially zero cost, is a sea change.... Over time, organizations and individuals will be able to extend their reach by orders of magnitude, often with a negligible sacrifice of richness .... The changing economics of

information threaten to undermine established value chains in many sectors of the economy, requiring virtually every company to rethink its strategy--not incrementally, but fundamentally."[5] Libraries as rich information providers with limited reach are among the institutions that are particularly vulnerable to this change. Communities and organizations will be able to rethink the strategies they have used to provide their members information. Libraries, which are encumbered with print collections and place-bound, could easily be left out of the strategies that emerge.

Though the institution of the library as we have known it may disappear, the societal functions it has served will need to be continued. For those of us who work in libraries now, this issue is critical. Libraries have been central to organizations and communities for many centuries. They would not have survived and prospered had they not provided value. As we consider radical change in the institutions we have worked in and managed, we need to be clear about what libraries are for. If we do not understand this, we will mismanage the inevitable evolution to new environments and institutions, which will certainly come in our lifetimes.

What Are Libraries For?

The primary function of most libraries for the last century and a half has been to make the artifacts that contain information--books, serials, newspapers, and their derivatives--easily and conveniently available to individuals in organizations and communities. Libraries have stored, organized, and preserved these artifacts in ways that no single individual could. While many people collect books, and most buy newspapers and magazines, libraries have been the place to go when one's personal collection was not sufficient, and the place for those with limited economic means to gain access to what they could not otherwise afford. Communities and organizations fund these activities because they recognize that libraries create a common good. Libraries make information more available to the individuals in communities and organizations than would be the case if individuals were left to their own devices. This in turn makes the organization more productive and enhances the quality of life in communities.

All of this is so obvious that it seems unnecessary to say it. Those of us who work in libraries know what libraries do, and we know why we do it. But in

this case, the obvious needs to be carefully considered. There has been significant confusion in much of the discussion of libraries in the post-print environment. To date, most of the discussion has focused on how libraries will adapt what they do to the new technology. Most of the discussion begins with the wrong question: "What do libraries do?" The answers address the ways in which technology can make the doing easier or more effective. By asking what libraries do, we are focusing on how to carry an existing institution forward into the new era. The correct question is "What are libraries for?" This question focuses on the societal good provided by libraries, and requires consideration of how that good will be provided With the new technology. This question forces us to ask whether libraries are the only, or even the best, means of making information easily and conveniently available.

Libraries as Information Subsidy

Libraries, in my view, can best be seen as the means through which communities and organizations subsidize information. In general, for as long as information has been contained in artifacts, and certainly for the last century, library buildings located reasonably close to the populations they serve, with staff to collect, organize, preserve, and assist in the use of printed materials, have been the most effective means of providing easy and affordable access to a rich information resource. The societal subsidy makes the collection available, and the user of the collection invests his or her time to travel to and work in the collection or to borrow materials from the collection to be used elsewhere.

This service is subsidized because it is recognized that without funding from a common pool, information will not be used to the extent that will provide the maximum benefit. Most often this pool is tax-supported. In part, the subsidy provides equitable access to information. As Peter Lyman states, "Public access to knowledge is of fundamental importance in a society where access to learning is subsidized in order to support a theory of social justice, which emphasizes equality of opportunity in the economy and democratic participation in the polity."[6] While open access to information is central to American society, a more fundamental reason for the creation of libraries is the uncertainty of information need. I do not know today all that I will need or want to know tomorrow. While I may be able to predict 80 percent of my needs and personally stockpile resources to meet those needs,

I can not predict the other 20 percent, and certainly can not, as an individual, purchase, organize, and store resources against all possible contingencies. In order to respond to the need to collect "just in case," organizations and communities pool resources to build backup collections to respond to unpredictable or expensive information needs. If they do not do this, individuals will be uninformed and unable to respond effectively to many situations. In addition, the common collection and the need to organize and support it creates bibliographic and human resources that would not be created by individuals. Finally, the serendipitous discovery, which comes from interacting with large and complex collections, enriches the results of individual information quests.

Libraries are thus like schools and roads. Education, the ability to travel and transport goods, and access to information are public goods, and unless a subsidy is provided, individuals will not use them to the extent that will provide the greatest benefit. But as with education and transport, there are alternative means of providing subsidies. Education can be provided with public schools or through vouchers or scholarships. Transportation can be provided by giving land to railroads or by building highways or airports. And as is the case for toll roads or scholarships, there is no need for the subsidy to be total.

In the world of networked information, alternative means exist to provide this access to information. Networked information does not require that physical collections be located near users, and the requirements for its organization and preservation are very different from print collections; however, a subsidy is still required if information is to be fully utilized and its benefit maximized. The way in which the subsidy is best applied will change, but not the need for the subsidy. This is the first and most important truth librarians need to understand as they move into the post-print world. The network without public subsidy will be as ineffective as the print world would have been without libraries.

Imagine 2018

Lets us digress for a moment and imagine what the not-too-distant future might look like to someone on an information quest. She will carry a lightweight notebook, or maybe projection glasses or an implant, with a wireless link to the network. Bandwidth is now easily capable of handling

high-resolution video and virtual-reality simulations. Free material on the Web is available in abundance and in the full range of quality and reliability. Yahoo! and its competitors have developed effective search engines, and a variety of software agents are available to continually search for items that match her personal profile. Dozens of groups of all stripes have "Good Housekeeping" seals of approval for the sites they sanction. Commercial information providers make proprietary databases available by subscription or pay-per-view, and advertising supports many sites. Validation technology has been developed to authenticate information, and storage is dirt-cheap.

There are no libraries in this picture. Further, there is arguably no need for them. Access devices and networks are cheap and easy, so even the least well-off are not disadvantaged. Intellectual access and validation, or gatekeeping, is provided by a variety of groups. The combination of technological solutions to information authentication and very cheap storage means archiving is not a concern.

So what is wrong? Information is available at a reasonable price. It is organized, and judgements are passed on its validity. Its preservation is at least as well assured as is paper-based information today. The problem is that the system lacks an information subsidy. Without the resources created by pooled common funds there is no way to share the risk of information uncertainty. Today, libraries and the services and products created for the library market act as information insurance. The networked world will require its own form of information insurance. Individuals will not subscribe to all of the information they might need any more than they now stockpile information of potential value; nor will they purchase all the information they might need in a pay-for-use environment. More importantly, information that is now produced for the library market, like many reference tools and much of the scholarly literature, would not be produced at all because it would not be commercially viable. The same would be true for most community information. The important questions are: What form will the information subsidy take? Where in the new system will the subsidy have the most effect? And, can a political consensus be built to support the subsidy?

Subsidies for Networked Information

I believe the subsidy in the networked environment will take two primary

forms. First, the purchase of rights to access proprietary content for the residents of a community or the members of an organization; and second, subsidy will create and place on the network content that is of value to the community but for which there is no profitable market.

Subsidy One: Community Access to Proprietary Content

This should sound very familiar. This form of subsidy is already widely practiced. Most library contracts for electronic information are site licenses that allow any member access to the purchased content. Increasingly, authorized users can exercise their right to use the information without regard for physical location or mode of network access. It is easy to imagine the "library" in academic settings to consist primarily of a number of site license agreements. In fact, the University of Phoenix claims to do exactly that today. Public libraries have a more difficult time with arrangements of this sort because information producers are concerned with the impact on business markets, but even here community wide access is provided. States have also purchased content access for all residents. Indiana's Project INSPIRE is a good example. Here $1 million in state funding purchased Internet access to well over two thousand full-text journals, including files on business and consumer health, with indexing and several encyclopedias and other reference tools. This resource is available to all nine million state residents.[7]

Implementing and maintaining support for this form of subsidy will probably be relatively easy. It is a simple market transaction--purchasing content on behalf of a group of individuals--and a logical extension o existing library services. These services, at least within organizations and local communities, are managed by their libraries and resource tradeoffs are made inside the library. Given this and the power and extended reach of electronic resources, the political support for this form of subsidy should be relatively easy to maintain.

However, the existence of state or multi-institution projects will cloud the issue. The politics will become more difficult when citizens ask why they need to spend their state tax dollars to support statewide information access and at the same time pay local taxes for a library that provides similar resources. University presidents will ask the same kind of question about consortium fees that seem to duplicate library budgets. This will be

especially difficult in the period of transition when one agency provides access to networked information and the other to paper-based collections. Once the transition is complete, local subsidy for information of particular value to the community can be added on top of resources provided by a larger political unit.

With this form of subsidy, organizations and communities will continue to make decisions about the level of subsidy they will provide to members. The level of subsidy will remain a part of the basis on which they compete. Equal access will be available inside communities and organizations, but not between them. Because organizations and communities are bounded entities, concerns for free riders are limited. Subsidized information is provided only to members, not to the world. Minimizing concerns over free riders makes building a political consensus on the support of subsidies much easier. But doing this in the unbounded area of the worldwide network will be a challenge. For this reason, organization and community-based subsidies will remain even though they may introduce inefficiencies.

Thus, it is easy to imagine the "library" as a small office with a couple of staff members who negotiate contracts with content providers, survey users, and lobby funding bodies. The content providers will be largely in the private sector and will create the content and the necessary, infrastructure. The library is effectively "out-sourced," and dollars once spent on buildings, printed materials, and staff are now spent on contracts that provide access rights.

Subsidy Two: Free and Open Distribution of Content

In some arenas underwriting free and open distribution of content will be simple and powerful, in others it will be difficult and politically complex. Applying subsidy in this way is easy when an agency already has a funded mission to create and distribute information and the application of network technology extends the reach or richness of the information. Governments at all levels are the best examples. Network technologies allow them to distribute widely and without mediation data they already collect. The transformation of the Government Printing Office's Depository Library Program is a good example, but a more dramatic example was the Pathfinder landing on Mars in July 1997 when NASA's Web site received 45 million visitors in a week.[8]

In many cases, however, most notably scholarly communication, this second form of subsidy will require the reformation of a complex web of gift relationships. To quote Lyman, "Nearly all knowledge is created and consumed within gift exchange systems, not markets--that is, by groups whose very social glue consists of sharing knowledge."[9] This is particularly true with scholarly publications. The system of scholarly communication requires authors and editors to contribute their time and energies, which they do to further both the pursuit of truth and their reputations. It also requires additional subsidy beyond this commitment of time. Not so long ago, subsidy entered the system through university presses that were partially funded by their universities, through scholarly societies that subsidized publications, and through libraries that provided a market for the publications of both groups. Over the past twenty-five years, the first two sources of subsidy have largely dried up and many items formerly published by nonprofit agencies have been taken over by for-profit publishers. The situation as it exists today has only one source of subsidy--library budgets--and much of the subsidy leaves the system when publishers take profits. This is the fundamental cause of crisis in scholarly publishing.[10] Libraries are often inefficient, and for-profit publishers deplete the subsidy pool. The single advantage of the existing system is that channeling subsidy into the system through libraries is widely accepted, if not widely understood.

Migrating scholarly communication to the networked environment will be technically straightforward, but migrating subsidy will be difficult because it will require dislocating existing social structures. A clear example of the problems can be seen in the conflict over "e-prints'--article preprints posted on Web sites. Perhaps the best know site is the Los Alamos physics archive (http://xxx.lanl.gov). This site posts unreviewed articles as well any subsequent commentary and revisions. The material is archived and preserved. The site is funded by the National Science Foundation and the U.S. Department of Energy, and currently serves more than 35,000 users in more than 70 countries. Traffic on the site surpasses 70,000 electronic transactions daily.[11] This means of scholarly communication bypasses traditional publishers and libraries, directly linking readers with authors. Importantly, it is subsidized by the federal government. The existence of this site and others like it have led to conflicts with established journals, which in some cases will not publish articles previously posted on the Web.[12] Such refusals often focus on the importance of peer review, but the real issue is control, either intellectual or commercial. As Paul Ginsparg, creator of the

Los Alamos site, stated in the New York Times, "The question is whether we can do without peer review as organized by multinational commercial publishers. If the answer is yes, the likely benefit is a far more efficient and far more functional system, better adapted to the needs of researchers."[13]

Clouding and confusing the issues surrounding contemporary scholarly communication is its continued commercialization and the responses of libraries and universities to the resulting price increases. The discussions usually begin with the unreasonable inflation in journal prices and move on to issues of the control of intellectual property, copyright, and often the decoupling of publication from tenure.[14] The conversations often result in name calling and accusations as librarians confront publishers.[15] Citing the usual concerns, the Association of Research Libraries created the Scholarly Publishing & Academic Resources Coalition (SPARC), whose mission is to be a catalyst for change through the creation of a more competitive marketplace for research information."[16] SPARC's first venture is an organic chemistry journal that will compete directly with a similar journal from a commercial publisher. The new journal will cost $2,300, compared with $8,000 for the commercial title. SPARC is funded by members, approximately 85 research libraries, who pay a small membership fee to the project and then agree to purchase publications produced under its auspices.[17]

It is interesting to compare the SPARC Project with the Los Alamos archive, because it highlights the challenges of migrating subsidies for scholarly information into a networked environment. SPARC has achieved reasonable support from the established institutions--research libraries and at least one scholarly society--and because of this has been able to channel limited dollars to subsidize a project that will create an old-style publication with limited distribution. The Los Alamos project, on the other hand, takes full advantage of network technology. But it is made possible only because of a subsidy from the federal government, which has a great interest in supporting this field of research. Ginsparg summarizes the experience of the Los Alamos project:

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A major lesson we learn is that the current model of funding
publishing companies through research libraries (in turn
funded by overhead on research grants) is unlikely to
survive in the electronic realm. It is premised on a paper
medium that was difficult to produce, difficult to
distribute, difficult to archive, and difficult to
duplicate--a medium that hence required numerous local
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redistribution points in the form of research libraries. The electronic medium shares none of these features and thus naturally facilitates large-scale disintermediation, with the resulting communication of research information both more efficient and more cost-effective.[18]

Ginsparg is certainly correct when he cites the advantages of the publishing system he has developed, both in richness and reach it surpasses anything libraries can achieve. Andrew Odlyzko's analysis places the cost of the Los Alamos e-server at $75 per article, compared with $2,000 to $4,000 for a print journal. He then goes on to say, "As Andy Grove of Intel points out, any time anything important changes in a business by a factor of 10, it is necessary to rethink the whole enterprise. Ginsparg's server lowers costs by about two orders of magnitude, not just one."[19] Clearly what Ginsparg has done will force some rethinking, but unless we clearly understand the basis of its success, it will not be duplicated. The Los Alamos project is successful because it receives its subsidy up front. This allows the system to be open and freely available to anyone, without concern that free riders will take advantage without paying their fair share. It allows authors and readers to use the system constrained only by their willingness to invest time and effort. This is the ideal way to develop and distribute knowledge in the networked world, but, critically, it requires upfront subsidy. Politically, the difficult task will be to find this subsidy in areas of scholarship that have a less compelling national interest than high-energy physics.

Libraries are in a particular bind. They are, in their own way, as reliant on the old system and its inefficiencies as the commercial publishers they so often vilify. This leads to projects such as SPARC that limit access rather than funding the open access that is often espoused by librarians. Beyond this, some librarians are actively looking for money-making ventures, usually by creating information products, often based on special collections.[20] A more appropriate response is to consciously join the gift exchange for scholarly information and provide open access to these resources. Of course, many universities do just this. But probably not with the clear understanding that they are subsidizing information for the world, and that by doing so they contribute to a commons with the hope, but not the certainty, that they will receive in proportion to what they give. For small-scale projects that do not obviously take away funding from other services and collections, this can be managed. But will a library or a university consciously fund a major project on this basis?

The Digital Library as Political Metaphor

If we look forward a decade or two and focus on how subsidies are used to support the free and open distribution of knowledge, two of the developments we see now will likely continue. First, communities and organizations will purchase proprietary content for their members. Much of this information will be produced in the private sector. While the library is likely to be the manager of this function, this is not a certainty. Organizations are likely to form consortia to leverage resources. It is also likely that community will be defined at different levels--city, county, state--and that they will all purchase content in order to balance local needs with local resources. Second, governments at all levels will subsidize the distribution of content they create, thus providing valuable community resources and more open governments.

The more problematic area will be the migration of the subsidy that supports the gift exchange system of scholarly communication and other nonprofitable information. It is harder to predict how subsidy can be distributed in this realm because it is hard to see how the free rider problem will be solved. Among the possibilities are:

1. Archives on the Los Alamos model, where upfront subsidy is provided by the federal government or other granting agency.

2. Archives funded by author fees, which in turn, in most cases, are subsidized by the author's organization or the grants that support his or her work. Ginsparg claims the economics of this arrangement are viable.[21]

3. Projects subsidized by a group of institutions, like those proposed by SPARC, which could be made open and freely available in cases where enough benefit is derived by the sponsoring organizations that they are not concerned with free riders. Scholarly societies could do this if they can escape the fear, or the reality, that they will lose members when the subsidized information is available to everyone.

4. Specialized resources created by organizations and made freely and openly available. Organizations would fund these resources either because they accept this as their contribution to the commons, to enhance their reputation, or because it supports a significant internal constituency. This

will be easiest in cases where the expansion into the network environment requires limited additional resources and substitutes for expensive print-based operations. A number of map libraries have been pioneers in this area.[22] I believe public libraries have an opportunity to create community-based resources in this way because most of the benefit will stay in the community, and free riders will be of limited concern.

5. Subsidies raised in a public-television model that combines government support, grants, memberships, and corporate sponsorship.

It is not clear that the library will be a major player in any of these models. But, if as librarians we understand what we are about, we have the ability to make major contributions. We have a significant advantage--organizations and communities are used to giving libraries money. This, combined with the ability of most of our users to get by with fewer print resources than we currently provide, offers an opening to redirect resources to projects that create freely and openly available networked resources. There are a variety of ways of doing this. The particulars are less important than the understanding that over time we will be cutting ourselves out of the loop. Libraries are artifact-bound, and the world we are moving into will be artifactless. This does not mean that individuals with the skills possessed by librarians will not have important roles to play, but rather that we will likely be doing them in a different institutional configuration.

For now, for the period of transition, I would suggest we talk about the subsidy in the information flow as the "digital library." Language matters, and the metaphors we use to talk about the future, will shape the future. As Lyman points out, the national debate on information policy shows little concern for, or understanding of, the public interest in free and open distribution of information. It is much more concerned with property rights and advantages in international trade.[23] Librarians should talk about "digital libraries" as a means of keeping the public debate focused on the need to create free and open resources in a networked environment that are comparable to those libraries provide in the print world. If we use this rhetoric to migrate the subsidy to the networked environment, we will be able to preserve the public good.

My fear is that we will try to make the digital library something more than a metaphor. An example is Ross Atkinson's discussion of the digital

library.[24] He suggests that libraries need to lay claim to a "control zone" in the digital environment. He wants to create a bounded collection that continues the historical role of libraries. This flawed approach will fail, and if it is pursued librarians will be relegated to a marginal role in the future. If, on the other hand, we understand what libraries are for, and care about this and not about preserving what we do, we can shape the public debate, and enhance the effectiveness of our organizations and the quality of our communities.

References and Notes

[1.] Marilyn Gell Mason, "The Yin and Yang of Knowing," Daedalus 125 (Fall 1996): 161. Walt Crawford and Michael Gorman make a similar case in great detail, but the range of their vision seems limited and bound in contemporary versions of rapidly evolving technology. See Walt Crawford and Michael Gorman, Future Libraries: Dreams, Madness, & Reality (Chicago: American Library Association, 1995).

[2.] Eli M. Noam, "Will Books Become the Dumb Medium?" Educom Review 33 (March 1998): 18-24; Andrew Odlyzko, "Silicon Dreams and Silicon Bricks: The Continuing Evolution of Libraries," Library Trends 46 (Summer 1997): 154-55.

[3.] There is some confusion about this issue. See for example Peter Lyman, "What is a Digital Library? Technology, Intellectual Property, and the Public Interest," Daedalus 125 (Fall 1996): 6. Lyman talks about computers as knowledge artifacts; I would suggest that it is better to talk about computers as appliances through which information is displayed. This semantic quibble is important because it makes clear the fundamental nature of the change we are facing.

[4.] Philip B. Evans and Thomas S. Wurster, "Strategy and the New Economics of Information," Harvard Business Review 75 (September/October 1997): 73.

[5.] Ibid, 74.

[6.] Lyman, "What is a Digital Library?" 26.

[7.] For information on the INSPIRE project, see the INSPIRE Web site at http://www.inspire-indiana.net/noframes/about. html.

[8.] Amy Harmon, "Mars Landing Signals Defining Moment for Web Use," New York Times (Late Edition), 14 July 1997: D1.

[9.] Lyman, "What is a Digital Library?" 27.

[10.] The current state of scholarly communication and some alternatives are nicely analyzed in Andrew Odlyzko, "The Economics of Electronic Journals," First Monday 2, no.8 (August 1997). Online. Available: http://www.firstmonday.dk/issues/ issue2_8/odlyzko/index.html. 24 July 1998.

[11.] For information on the site, see Paul Ginsparg, "Winners and Losers in the Global Village." Online. Available: http://xxx.lanl.gov/blurb/pg96unesco.html. 16 July 1998. See also, Katie Hafner, "Physics on the Web Is Putting Journals on the Line," New York Times, 21 April 1998: F3.

[12.] See Lisa Guerney and Vincent Kiernan, "Journals Differ on Whether to Publish Articles That Have Appeared on the Web," Chronicle of Higher Education, 17 July 1998: A27.

[13.] Hafner, "Physics on the Web Is Putting Journals on the Line," F3.

[14.] See, for example, "Scholarly Communication and the Need for Collective Action," ARL Discussion Paper, October 1997. Online. Available: http://www.arl.org/sparc/discuss. html. 16 July 1998. See also "To Publish and Perish," Policy Perspectives 7 (March 1998): 1-12.

[15.] See, for example, Lisa Guernsey "Exploring the Future of Electronic Books and Journals," Chronicle of Higher Education, 19 June 1998: A27.

[16.] "ARL Promotes Competition in Scholarly Publishing," 24 October 1997. Online. Available: http://www.arl.org/ sparc/sparc.html. 16 July 1998. See also Mary M. Case, "ARL Promotes Competition through SPARC: The Scholarly Publishing & Academic Resources Coalition." Online. Available: http://www.arl.org/newsltr/196/sparc.html. 16 July 1998.

[17.] Vincent Kiernan, "University Libraries Join With Chemical Society to Create a New, Low-Cost Journal," Chronicle of Higher Education, 10 July 1998: A20.

[18.] Paul Ginsparg, "Winners and Losers in the Global Village."

[19.] Andrew Odlyzko, "The Economics of Electronic Journals."

[20.] See, for example, Lisa Guernsey, "Digital Presses Transform Librarians Into Entrepreneurs: Projects at the U. of Cincinnati and Elsewhere Reflect Drive to Make Money from Rare-book Holdings," Chronicle of Higher Education, 22 May 1998: A27.

[21.] Paul Ginsparg, "Winners and Losers in the Global Village."

[22.] See, for example, Patrick McGlamery, "Identifying Issues and Concerns: The University of Connecticut's MAGIC--A Case Study," Information Technology and Libraries 14 (June 1995): 116-22.

[23.] Peter Lyman, "What is a Digital Library?" 23.

[24.] Ross Atkinson, "Library Functions, Scholarly Communication, and the Foundation of the Digital Library: Laying Claim to the Control Zone," Library Quarterly 66 (July 1996): 239-65.

David W. Lewis (dlewis@iupui.edu) is Deputy University Librarian at Indiana University Purdue University Indianapolis.